

REMARKS

Applicant respectfully requests reconsideration of this application as amended.

The drawings have been objected to under 37 C.F.R. 1.83(a) as not showing every feature of the invention specified in the claims.

Claims 1-3, 5-13, 23 and 25-27 are pending in this application.

Claims 4, 14 and 24 have been cancelled.

No claims have been added.

Claims 1, 23 and 27 have been amended.

Claim 14 has been objected to under 37 C.F.R. 1.75(c) and rejected under 35 U.S.C. §112, fourth paragraph, as being of improper dependent form for failing to further limit the subject matter of a previous claim from which claim 14 depends.

Claims 1, 3, 6-7, 9, 13, 23 and 25-27 were rejected under 35 U.S.C. §102(e) as being unpatentable over U.S. Patent No. 6,136,128 issued to Chung (hereinafter referred to as "Chung").

Claim 5 was rejected under 35 U.S.C. §103(a) as being considered unpatentable over Chung in view of U.S. Patent No. 6,215,180 issued to Chen et al (hereinafter referred to as "Chen").

Claims 8, 10-12 and 14 were rejected under 35 U.S.C. §103(a) as being considered unpatentable over Chung, alone.

Claims 1-4, 6-14 and 23-27 were rejected under 35 U.S.C. §103(a) as being considered unpatentable over Applicant's admitted prior art (hereinafter referred to as "the APA") in view of Chung.

Claim 5 was rejected under 35 U.S.C. §103(a) as being considered unpatentable over the APA in view of Chung, and further in view of Chen.

37 C.F.R. 1.83(a) Objection to Drawings

The Examiner has objected to the drawings as not providing support for electrical connections formed through the substrate, a pin grid array package having at least one break in the pattern, a ball grid array package having at least one break in the pattern, vent holes formed on the lid of a package having at least one break in the pattern, and a package having a chip with controlled collapsed chip connections and at least one break in the pattern. In response, Applicant is submitting herewith proposed new Figures 3b, 3c, 4b and 4c, and is proposing to renumber Figures 3 and 4 as Figures 3a and 4a, as shown in accompanying red-lined pages of drawings. Also accompanying these changes to the drawings are minimal amendments to the text of the specification, offered herein. Proposed Figures 3b, 3c, 4b and 4c, the proposed renumbering of Figure 1 as Figure 1a, and the offered amendments to the specification serve to do nothing more than to provide specific illustration of aspects already presented in the specification and/or claims as originally filed. Applicant has added no new matter with these proposed drawing changes or amendments.

Accompanying this Amendment is (1) a separate document entitled "Request to Approve Drawing Changes" and (2) sketches prepared in accordance with 37 C.F.R. § 1.123 showing the proposed changes in red ink.

Applicant respectfully submits that proposed new versions of Figures 3a-3c and 4a-4c meet the requirements of 37 C.F.R. § 1.83.

37 C.F.R. 1.75(c) Objection to and 35 U.S.C. §112 Rejection of Claim 14

The Examiner has both objected to and rejected claim 14 as being of improper dependent form for failing to further limit the subject matter of and failing to include every limitation of a claim from which claim 14 depends. Specifically, it is stated in the office action that claim 14 is directed to a testing

procedure device while claim 1, from which claim 14 depends, is directed to a semiconductor device. It is further stated that claim 14 does not specify a further limitation of the subject matter (i.e., a package structure) of claim 1.

Applicant has cancelled claim 14, thereby rendering this objection and this rejection moot.

35 U.S.C. §102(e) Rejection of Claims 1, 3, 6-7, 9, 13, 23 and 25-27

The Examiner has rejected claims 1, 3, 6-7, 9, 13, 23 and 25-27 under 35 U.S.C. §102(b) as being considered to be anticipated by Chung. Applicant respectfully submits that claims 1, 3, 6-7, 9, 13, 23 and 25-27 are not anticipated by Chung, because Chung does not teach each and every element of Applicant's invention as claimed.

Specifically, regarding independent claims 1 and 23, Applicant respectfully submits that Chung does not teach sealant disposed between the substrate and the lid in a pattern with at least one break in the pattern remaining subsequent to the substrate and the lid being assembled together.

Chung does disclose having at least one gap in the adhesive prior to the assembling together of the lid and substrate "to avoid the so-called 'blow-out' problem caused by gas trapped in the interior of a lid or cover that, when heated during the lid attachment process, ruptures the adhesive attachment between the lid and the package" (lines 49-52 of column 10). Chung further teaches that each gap "is narrow enough to permit entrapped gas molecules to pass, but narrow enough to be closed by the flowing of the adhesive 30 when cover 40 is attached to a substrate 20" (lines 62-65 of column 10) so that "the protective cover is attached to substrate 20 by a continuous line of adhesive" (lines 11-12 of column 4). Therefore, in Chung, gaps in the sealant (or "adhesive") are not taught to remain when assembly of the package is complete, but become closed.

Also regarding independent claims 1 and 23, Applicant respectfully submits that Chung also does not teach having thermal attach disposed between the inner surface of the lid and the die. The text of Chung makes no reference to such disposing of thermal attach, and the figures of Chung show only unfilled space between an inner surface of a lid and the die.

Claims 3, 6-7, 9, 13 and 25-27 variously depend, either directly or indirectly, from claims 1 and 23, and therefore, incorporate all of the limitations of claims 1 and 23.

For at least these reasons, Applicant respectfully submits that claims 1, 3, 6-7, 9, 13, 23 and 25-27 are patentably distinguished over Chung, and are in condition for allowance.

35 U.S.C. § 103(a) Rejection of Claim 5

The Examiner has rejected claim 5 under 35 U.S.C. § 103(a) as being considered to be unpatentable over Chung in view of Chen.

Applicant respectfully submits that claim 5 depends from independent claim 1, and therefore, incorporates all of the limitations of claim 1, which Applicant has asserted is patentably distinguished over Chung.

Furthermore, to establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). (MPEP 2143.03).

Applicant respectfully submits that, as discussed, above, Chung does not teach or suggest all the features of Applicant's invention as claimed. Specifically, as discussed above, Chung does not teach or suggest a sealant disposed between the substrate and the lid in a pattern with at least one break remaining subsequent to the substrate and lid being assembled together. Chen also does not teach or suggest this limitation, and therefore, there can be no combination of

Chung and Chen that teaches this limitation. This deficiency is not cured by the possibility of a teaching or suggestion by Chen to form a vent-hole through the lid.

For at least these reasons, Applicant respectfully submits that claim 5 is patentably distinguished over any combination of Chung and Chen, and is in condition for allowance.

35 U.S.C. § 103(a) Rejections of Claims 8, 10-12 and 14

The Examiner has rejected claims 8, 10-12 and 14 under 35 U.S.C. § 103(a) as being considered to be unpatentable over Chung, alone.

Applicant respectfully submits that claims 8 and 10-12 depend, directly or indirectly, from independent claim 1, and therefore, incorporate all of the limitations of claim 1, which Applicant has asserted is patentably distinguished over Chung. Claim 14 has been cancelled, thereby rendering this rejection of claim 14 moot.

For at least these reasons, Applicant respectfully submits that claim 8 and 10-12 are patentably distinguished over Chung, and are in condition for allowance.

35 U.S.C. § 103(a) Rejection of Claims 1-4, 6-14 and 23-27

The Examiner has rejected claims 1-4, 6-14 and 23-27 under 35 U.S.C. § 103(a) as being considered to be unpatentable over the APA in view of Chung.

Applicant respectfully submits that claims 2-3, 6-13 and 25-27 variously depend, either directly or indirectly, from independent claims 1 and 23, and therefore, incorporate all of the limitations of claims 1 and 23, which Applicant has asserted is patentably distinguished over Chung. Claims 4, 14 and 24 have been cancelled, thereby rendering this rejection of claims 4, 14, and 24 moot.

Furthermore, to establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). (MPEP 2143.03).

Applicant respectfully submits that, as discussed, above, Chung does not teach or suggest all the features of Applicant's invention as claimed. Specifically, as discussed above, Chung does not teach or suggest a sealant disposed between the substrate and the lid in a pattern with at least one break remaining subsequent to the substrate and lid being assembled together. Also, as acknowledged at the top of page 10 of the office action, the APA also does not teach or suggest at least one break in the pattern, either. Therefore, there can be no combination of Chung and the APA that teaches this limitation.

For at least these reasons, Applicant respectfully submits that claim 5 is patentably distinguished over any combination of Chung and Chen, and is in condition for allowance.

#### 35 U.S.C. § 103(a) Rejection of Claim 5

The Examiner has rejected claim 5 under 35 U.S.C. § 103(a) as being considered to be unpatentable over the APA in view of Chung, and further in view of Chen.

Again, Applicant respectfully submits that claim 5 depends from independent claim 1, and therefore, incorporates all of the limitations of claim 1, which Applicant has asserted is patentably distinguished over Chung and Chen, as well as any combination of Chung and Chen.

For at least these reasons, Applicant respectfully submits that claim 5 is patentably distinguished over any combination of Chung, Chen and the APA, and is in condition for allowance.

Condition for Allowance

Applicant submits that all rejections and objections have been overcome and the present application is now in condition for allowance. If there are any additional charges or shortages related to the present communication, please charge our Deposit Account No. 02-2666.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the paragraph starting on line 15 of page 7:

Figure 3a is a top side view similar to that of Figure 2, and Figure 3b is a sectional view similar to that of Figure 1, but depicting an embodiment of the present invention along the side view depicted by Figure 3c. Items of package 300 of [Figure 3] Figures 3a-c being labeled with 3xx numbers that correspond to the 2xx numbers of the labeled items of package 200 of Figure 2. Just as with Figure 2, what would have been a lid and thermal attach corresponding to lid 110 and thermal attach 116, respectively, of Figure 1 have been removed from the package depicted in Figure 3a to allow the relative position of other items under the lid to be seen. As depicted in [Figure 3] Figures 3a-3c, the exterior of package 300 is comprised of substrate 312 and sealant segments 314a through 314d. Also as shown, die 330 is substantially centered relative to substrate 312, and is attached to substrate 312 via underfill 320 and solder balls 322 (also known as C4 bumps, like solder balls 122 of Figure 1) [which is] with underfill 320 shown protruding from underneath and just beyond the edges of die 330. Similarly to solder balls 122 of Figure 1, solder balls 322 provide electrical connections between die 330 and substrate 312. Also similarly to Figure 1, substrate 312 is a printed circuit board with conductors 313 forming electrical connections between solder balls 322 and solder balls 324.

In the paragraph starting on line 1 of page 8:

Like sealant 214 of Figure 2, the sealant used in the embodiment of [Figure 3] Figures 3a-c is disposed to correspond to where lid 310 meets [the lid (not shown) would meet] with substrate 312, so as to bond [the lid] lid 310 to substrate 312. However, unlike sealant 214 of Figure 2, the sealant used in this

embodiment does not form an unbroken line that surrounds die 330. Instead, the sealant is disposed in four sealant segments 314a-d, leaving breaks between the segments through which pressure that would otherwise build up within the interior of package 300 as a result of moisture being turned to steam when the temperature within the package increases may be released.

In the paragraph starting on line 10 of page 8:

Referring variously to both Figures 1 and [3] 3a-c, by allowing this release of pressure, lid 310 [the lid (not shown in Figure 3, but correspondingly shown as lid 110 in Figure 1)] is not caused to be pushed away relative to substrate [112/]312. As a result, the pressure exerted by [the lid] lid 310 on thermal attach 316 [the thermal attach (not shown in Figure 3, but correspondingly shown as thermal attach 116 in Figure 1)] that conducts heat away from die [130/]330 to [the lid] lid 310 is [not] reduced, and the effectiveness of the thermal attach in conducting away such heat is preserved.

In the paragraph starting on line 12 of page 9:

In one embodiment, the sealant is comprised of a relatively flexible material permitting substrate 312 and lid 310 [the lid (not shown)] to move relative to each other with a high degree of freedom. In another embodiment, the sealant is comprised of a more rigid material limiting the relative movement of substrate 312 and [the lid] lid 310.

In the paragraph starting on line 17 of page 9:

In one embodiment package 300 would be formed by first attaching die 330 to substrate 312, thereby forming physical and electrical connections between die 330 and substrate 312. The sealant would then be disposed on substrate 312

in the four segments 314a-d, where [the lid (not shown)] lid 310 is to be attached to substrate 312. Thermal attach 316 [(not shown)] would then be disposed on die 330, where [the lid (not shown)] lid 310 is to be attached to die 330. Then [the lid] lid 310 would be attached to substrate 312 (via sealant 314a-d) and die 330 (via [the] thermal attach 316). As those skilled in the art will understand, the order in which these occur may be changed without departing from the spirit of the invention.

In the paragraph starting on line 10 of page 10:

In one embodiment, [the lid (not shown)] lid 310 has one or more vent-holes, such as vent-hole 311, formed therethrough, that could also serve to permit the release of pressure within the interior of package 300, but which may be blocked as a result of the manner in which package 300 is installed, either for testing or for normal use. In another embodiment, the lid has no vent-holes formed therethrough, and the breaks between sealant segments 314a-314d are the sole means provided for release of pressure.

In the paragraph starting on line 17 of page 10:

In one embodiment, [the thermal attach (not shown)] thermal attach 316 is a thermal grease, while in another embodiment, [the] thermal attach 316 is a thermal adhesive.

In the paragraph starting on line 19 of page 10:

In one embodiment, [the lid (not shown)] lid 310 is made of material capable of conducting heat away from die 330, such as copper or aluminum. In one embodiment, [the lid] lid 310 releases the heat conducted away from die 330 to ambient air surrounding package 300. In another embodiment, [the lid] lid

310 conducts the heat to other thermally conductive apparatus with which [the lid] lid 310 is in contact, such as a heatsink (or heat spreader), heat pipe, or thermal electric cooler.

In the paragraph starting on line 10 of page 11:

Figure 4a is a top side view similar to that of Figure 3a, and also depicts an embodiment of the present invention. [Figure 4 is] Figures 4a-c are provided to show an alternate pattern by which the sealant may be disposed to correspond to where [the lid (not shown)] lid 410 would meet with substrate 412, so as to bond [the lid] lid 410 to substrate 412. Although the patterns in both Figures 3a and 4a are both substantially rectangular, the breaks in the sealant in package 400 are at the corners of the substantially rectangular pattern, instead of being at the sides as in the case of package 300. Items of package 400 of [Figure 4] Figures 4a-c being labeled with 4xx numbers that correspond to the 3xx numbers of the labeled items of package 300 of [Figure 3] Figures 3a-3c. Just as with Figure 3a, what would have been a lid and thermal attach corresponding to lid 110 and thermal attach 116 (namely, lid 410 and thermal attach 416), respectively, of Figure 1 have been removed from the package depicted in Figure [3] 4a to allow the relative position of other items under the lid to be seen. Also just as with Figures 3a-c, die 430 is substantially centered relative to substrate 412, and is attached to substrate 412 via underfill 420 and solder balls 422 (also known as C4 bumps, like solder balls 122 of Figure 1) with underfill 420 shown protruding from underneath and just beyond the edges of die 430. Also, solder balls 422 provide electrical connections between die 430 and substrate 412, which is a printed circuit board with conductors 413 forming electrical connections between solder balls 422 and pins 424 (pins 424 being appropriate for a pin grid array package, whereas balls 324 were appropriate to a ball grid array package).

1. (Amended) A package, comprising:

a substrate with an inner surface to which a die is to be attached, forming electrical connections through the substrate, between the die and the exterior of the package;

a lid with an inner surface facing the inner surface of the substrate;

thermal attach disposed between the die and the inner surface of the lid;

and

sealant disposed between the substrate and the lid in a pattern with at least one break in the pattern remaining subsequent to the substrate and lid being assembled together.

23. (Amended) An [electronic device] apparatus, comprising:

a substrate with an inner surface;

a lid with an inner surface facing the inner surface of the substrate;

a die on which electronic circuitry is disposed, enclosed between the substrate and the lid, and attached to the inner surface of the substrate which provides electrical connections between the die and the exterior of the package;

thermal attach disposed between the die and inner surface of the lid; and

sealant disposed between the substrate and the lid in a pattern with at least one break in the pattern remaining subsequent to the substrate and lid being assembled together.

27. (Amended) The [method] apparatus of claim 23, wherein the die is attached to the substrate using a controlled collapsed chip connection.